

# CSE310 (75637&87190) Data Structures and Algorithms, Fall 2022

**Instructor: Professor Guoliang Xue**

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**Office Hours: TBA**

**TAs and Office Hours:**

**TBA**

**Lectures for 75637:** TTH 1:30pm-2:45pm, PSH153

**Lectures for 87190:** TTH 3:00pm-4:15pm, PSH152

## CATALOG DESCRIPTION:

Advanced data structures and algorithms, including stacks, queues, trees (B, B+, AVL), and graphs. Searching for graphs, hashing, and external sorting.

## PREREQUISITES:

Being able to program in C++. These are taught in CSE220 and CSE240.

Being able to perform mathematical proofs. These are taught in MAT243.

## TEXT BOOK AND OTHER MATERIALS:

Cormen, T. H., Leiserson, C. E., and Rivest, R. L., C. Stein, *Introduction to Algorithms*, The MIT Press, 4th edition.

## COURSE OBJECTIVE AND EXPECTED LEARNING OUTCOME:

Students who complete this course can

1. Define data structures (types) such as heaps, balanced trees, hash tables.
2. Explain how to use a specific data structure in modeling a given problem (e.g. I can explain how to model a dictionary using balanced trees).
3. Identify, construct and clearly define a data structure that is useful for modeling a given problem.
4. State some fundamental algorithms such as merge sort, topological sort, Prim's and Kruskal's algorithm, and algorithmic techniques such as dynamic programming and greedy algorithms.
5. Use a specific algorithmic technique in solving a given problem (e.g. I can write a dynamic program that solves a shortest-path problem).
6. design an algorithm to solve a given problem
7. Define the notions of worst-case/best-case/average-case running times of algorithms.
8. Analyze and compare different asymptotic running times of algorithms.
9. Analyze a given algorithm and determine its asymptotic running time.
10. Combine fundamental data structures and algorithmic techniques in building a complete algorithmic solution to a given problem.
11. Create several algorithmic solutions to a given problem and choose the best one among them according to given requirements on time and space complexity.

## **COURSE ASSESSMENT PLAN:**

50%: Closed-Book Exams (midterm01=15%, midterm02=15%, final=20%)

25%: Written Assignments

25%: Programming Projects

**A weighted average of 90 or more guarantees a letter grade in the A range (A+, A, A-). A weighted average of 80 or more (but below 90) guarantees a letter grade in the B range (B+, B, B-). A weighted average of 70 or more (but below 80) guarantees a letter grade in the C range (C+, C). A weighted average of 60 or more (but below 70) guarantees a letter grade D. Students with a weighted average of 70 or more can also get the Y grade.**

## **ABOUT THIS COURSE:**

This course supports the Computer Science program and the Computer Systems Engineering program by providing a background in the analysis and synthesis of algorithms for simple problems (CSa,j/CSEa). Students understand basic and advanced data structures and algorithms and apply knowledge of computing and mathematics to design, implement and evaluate solutions to problems (CSc/CSEc). This course serves as a prerequisite for most advanced courses.

Data Structures and Algorithms is a fundamental course to CSE majors. Students will learn important techniques to store data and to process data efficiently. Data structures and algorithms cannot be separated. On one hand, good data structures help in the design of efficient algorithms. On the other hand, good data structures are discovered during the design of efficient algorithms.

This course requires a lot of work. Depending on different knowledge levels the students may have, all students may not be required to spend the same amount of time on this course. However, every student is encouraged to preview before the class and review immediately after the class.

Students are encouraged to ask questions in class, and to fully use the office hours of the instructor and the TAs. Students may also ask questions via email to the instructor and/or the TAs. However, the instructor and the TAs may choose to ignore questions on topics well covered in class and from students not attending the lecture(s).

There will be closed book tests and many heavyweight homeworks. Homeworks may involve theoretical contents as well as programming contents. The instructor will also assign suggested readings/exercises after each lecture. Students should work on these before the next lecture day but will not hand in the solutions to the exercises. Very often, solutions to these exercises can be found on the Internet. It is not cheating to get the solutions on the Internet. Discussion on these exercises are encouraged. However, you will gain only after you can understand the materials.

## **DETAILED SCHEDULE OF TOPICS:**

- ❖ Introduction and Asymptotic Notations (4 lectures)
- ❖ Worse-case Analysis (3 lectures)
  - Insertion Sort
  - Quicksort: Divide-and-Conquer
  - Merge Sort, Activation Record
- ❖ Lower Bound and Optimal Sorting (2 lectures)
  - Lower Bound for Sorting

- Heap and Heapsort
- ❖ Disjoint Sets: Amortized Analysis (2 lectures)
- ❖ **Midterm 01** : To be announced one week ahead of time
- ❖ Graph Algorithms (7 lectures)
  - Depth-First Search
  - Breadth-First Search
  - Shortest Paths
  - MST: Greedy Algorithms
  - Topological Sort
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- ❖ **Midterm 02**: To be announced one week ahead of time
- ❖ Hashing (2 lecture)
- ❖ Binary Search Trees, Red-Black Trees (2 lectures)
- ❖ Medians and Selection in Linear Time (2 lectures)
- ❖ Introduction to Dynamic Programming (3 lectures)
  - Longest Common Subsequences
  - Matrix Chain Multiplication
- ❖
- ❖ **Final Exams**: **December 8, 12:10pm-2:00pm (75637)** and **December 6, 2:30pm-4:00pm (87190)**.

## 1. Absence & Make-Up Policies

Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on [ACD 304-04](#), “Accommodation for Religious Practices” and [ACD 304-02](#), “Missed Classes Due to University-Sanctioned Activities.”

All homework assignments are due by its specified due date/time. In general, no late assignment will be accepted. If you fall into one of the special cases defined in this syllabus, you need to talk to the instructor early. It is the instructor’s decision whether or not you will receive an extension or an opportunity for makeup.

In describing the policies, there will be some special cases in reference. I will honor the following special cases (rules stated):

- **Medical Problems**: Within two days, you need to submit a statement with the signature of the doctor and the seal of the hospital saying that you cannot come to class during a particular time.
- **Travel Accident**: Within two days, you need to submit a police report stating that you are involved in an accident or your car broke down while you are traveling to school. Your car does not start at home is not a valid reason.
- **Death of an Immediate Family Member**: If you need to attend the funeral of an immediate family member (defined as grand-parent, parent, spouse, sibling or child), you need the instructor's prior approval. Proof is required.

Final Exam is pre-scheduled by the University before registration opened up, and will not be changed. The dates of midterms will be announced in class one week before the test. To maintain fairness to the whole class, there will be no makeup for missed exams/assignments/classes in general.

If you have to miss an exam due to ASU official business (e.g. presenting a research paper at a conference, competing as a team member of ASU in an event, etc.), you can make a request a week to the instructor a week ahead with supporting letters from your advisor/coaches. These requests will most likely be approved by the instructor.

If you missed an exam/assignment due to your own medical problem, you may request a makeup by submitting an official notice from the hospital within two days of the event. The instructor may consider your request. If you missed an exam/assignment due to your own travel accident, you may request a makeup by submitting a copy of the police report on the day of the event. The instructor may consider your request. If you have to miss an exam/assignment due to the death of an immediate family member (defined as grand-parent, parents, spouse, sibling or child), you need the instructor's prior approval. Proof is required.

In general, for situations beyond human control, the instructor will consider the request. However, for situations within human control, the instructor will deny the request for a makeup. The following are some examples within human control, and request for a makeup will be denied.

- I have to miss a class/assignment/exam because my parents/friends are visiting me on that day.
- I have to miss a class/assignment/exam because I will have my wedding during those days.
- I have to miss a class/assignment/exam because I have to help my father/mother/friend who needs help.
- I have to miss a class/assignment/exam because I will have already bought my airline ticket to go somewhere.

## **2. Grade Appealing:**

Your grades will be posted on canvas, available to you. Whenever the grade for a particular work is available, we will post an announcement. You will have one week to challenge the grade in writing, by an email to the instructor and copying to the TAs. If you do not contact either the instructor or the TAs within a week, there would be no change to your grade for that particular work. This applies to all of your graded work.

## **3. Readings, Assignments, Examinations, Required Activities**

The textbook is required. Lecture slides will be posted on canvas the day before the lecture. Final exam date/time is decided by ASU, which will not be changed. Midterm exams will be announced at least one week prior.

## **4. Classroom Behavior**

Cell phones and pagers (must be/or state alternative rule) turned off during class to avoid causing distractions. The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

## **5. Academic Integrity**

All students in this class are subject to ASU's Academic Integrity Policy (available at <http://provost.asu.edu/academicintegrity>) and should acquaint themselves with its content and requirements, including a strict prohibition against plagiarism. All violations will be reported to the Dean's office, who maintain records of all offenses. Students are expected to abide by the FSE Honor Code (<http://engineering.asu.edu/integrity/>).

## **6. Disability Accommodations.**

Suitable accommodations will be made for students having disabilities and students should notify the instructor as early as possible if they will require same. Such students must be registered with the Disability Resource Center and provide documentation to that effect.

## **7. Sexual Discrimination**

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available if you wish discuss any concerns confidentially and privately.

Notice: Any information in this syllabus (other than grading and absence policies) may be subject to change with reasonable advance notice.

Notice: All contents of these lectures, including written materials distributed to the class, are under copyright protection. Notes based on these materials may not be sold or commercialized without the express permission of the instructor. [Note: Based on [ACD 304-06.](#)]